The Response of Aquatic Invertebrates to the Removal of the Invasive Prussian Carps in the Muumilampi Pond

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Introduction

The Muumilampi pond locates in the Viikki Natura of Vanhankaupunki, Helsinki (Figure 1). The Muumilampi pond is named after its shape that looks like a Finnish comic character, Muumin, by Tove Jansson.

Viikki Natura is also known as "Vanhankaupunginlahden Lintuvesi Natura 2000", literally meaning "Natura 2000 of the Old Town Bay bird wetlands". As its name suggests, this area provides important habitats for birds.[1] A wide range of bird species has been found in the Natura 2000, including vulnerable species, such as Common Mergansers (*Mergus merganser*)[2]. Besides, the Natura 2000 is also home to other wildlife, such as Moor Frogs (*Rana arvalis*) [3] and Roe Deers (*Capreolus capreolus*)[3].

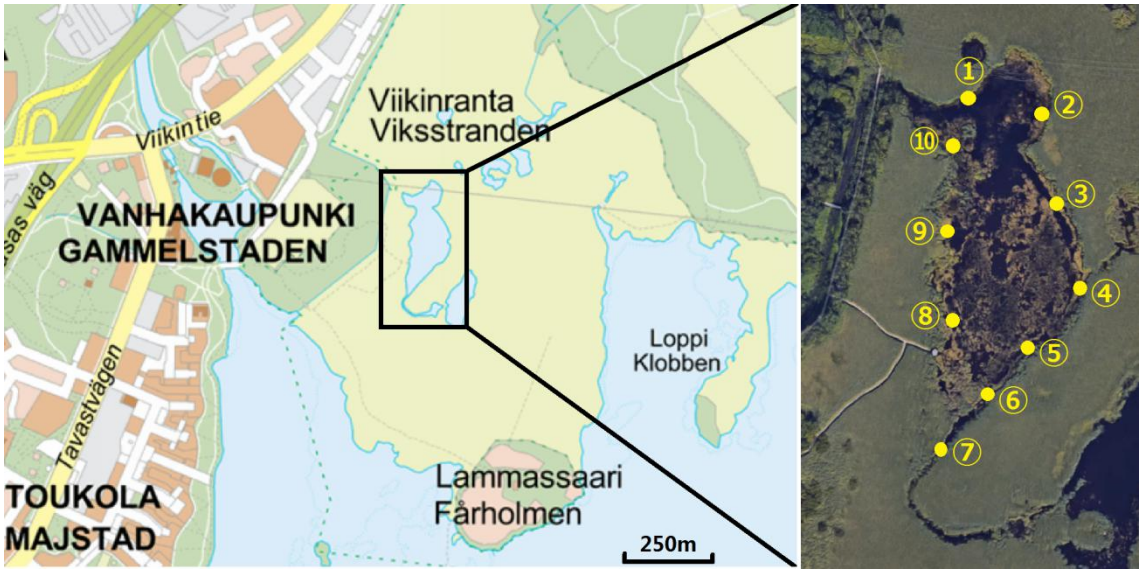

Figure 1. The location of the Muumilampi pond and the sampling spots.

The Natura 2000, however, was found to suffer from invasive alien species. The Muumilampi was invaded by an alien fish species, the Prussian carps (*Carassius gibelio*). The Prussian carps competed out native fish and had been the dominant species of the Muumilampi fish community. This invasive alien species also led to simple aquatic invertebrate community, which reduced food availability for many waterbirds. Since 2016, the City of Helsinki has been clearing out the Prussian carps from the pond every summer. The purpose of this survey is to investigate if the removal of the Prussian carps has helped aquatic invertebrates recolonise the Muumilampi pond comparing to the survey result in 2014.

Materials and Methods

This survey was taken place on 25th July 2018. Invertebrates at 10 spots along the Muumilampi pond edge (Figure 1) were surveyed with a D-shaped handnet with a 3mm-mesh net bag. Each spot was sampled by sweeping the handnet 10 times over a one-minute time interval. The samples were preserved in a 2-litre plastic bag and kept in cold till identification in the laboratory with a microscope.

Spiders (Arachnida), snails (Gastropoda), shells (Bivalvia), Asellidae, and most of the aquatic insects (Insecta) were identified to the species level. Leech (Hirudinea), fly larvae (Diptera), water skippers (Gerridae), and caddisfly (Trichoptera) were identified to a higher level (Appendix 1).

Results and Discussion

Although the invertebrates surveyed in 2014 was not identified to the species level, we can still see the taxa number was higher in 2018. In total, 13 taxa were found in the Muumilampi pond in 2018, while only 7 taxa were found in 2014 (Table 1).

Among the 13 taxa, 23 species were identified (Appendix 1). Yet no rare invertebrate species were found in this survey. Comparing to the data collected in 2014, the small-sized invertebrates, such as Copepoda and water mites (Hydracarina), were not

found in 2018, very likely due to the sampling methods. The abundance of small predators increased in the Muumilampi pond after the City of Helsinki fished the Prussian carps (*Carassius gibelio*) for three summers since 2016. These small predators include dragonflies, damselflies, aquatic spiders, aquatic beetles, backswimmers, water boatmen, and damselflies.

The biomass index based on body length (class II - V) was higher in 2018 than in 2014 (Figure 2). No individuals of the body length class I (0 - 2.5 mm) was found in 2018, which was mainly due to that the handnet mesh was 3 mm large. The biomass index shows that middle-sized to large-sized invertebrates increased, A similar pattern can also be seen from the abundance contribution of each body length class (Figure 3). Both patterns indicate that fishing the Prussian carps was an effective action to help aquatic invertebrates recolonise the Muumilampi pond.

Table 1. Taxa found and their abundance in 2014 and 2018.

Taxa	Common Names	Finnish Names	2014	2018
Anisoptera	dragonflies	aitosudenkorennot	0	5
Araneae	spiders	hämähäkit	0	32
Asellidae	water lice	vesisiirat	0	29
Chironomidae	nonbiting midges	surviaissääsket	0	74
Coleoptera	beetles	kovakuoriaiset	0	10
Copepoda	-	hankajalkaiset	105	0
Corixidae	water boatmen	pikkumalluaiset	9	10
Ephemeroptera	mayflies	päivänkorennot	33	0
Gastropoda	snails	kotilot	7	106
Gerridae	water striders	vesimittarit	0	1
Hirudinea	leeches	juotikkaat	0	4
Hydracarina	water mites	vesipunkit	1	0
Notonectidae	backswimmers	isomalluaiset	0	6
Oligochaeta	worms	harvasukasmadot	2	0
Trichoptera	caddisflies	vesiperhoset	0	5
Veneroida	-	simpukat	0	5
Zygoptera	damselflies	hentosudenkorennot	1	8

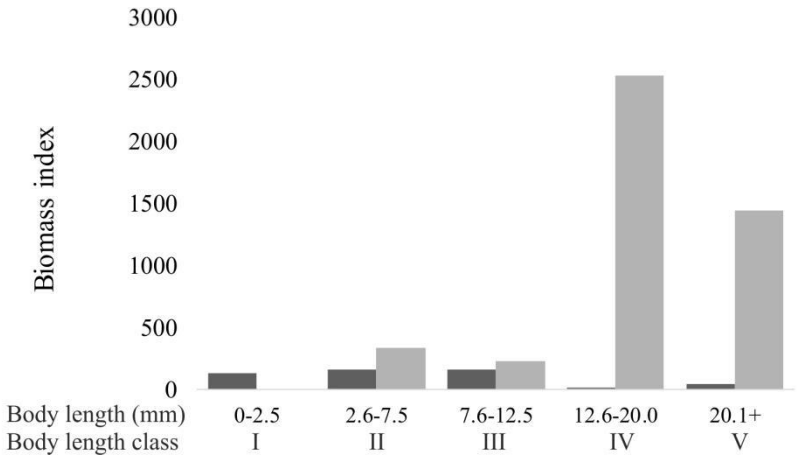

Figure 2. The biomass index of each body length class in 2014 and 2018.

In 2014, the small-sized invertebrates (class I - II) were the main contributors to the aquatic invertebrate community in the Muumilampi. After fishing the Prussian carps for three summers, the large-sized invertebrates (class IV - V) became the main contributors to the community (Figure 3).

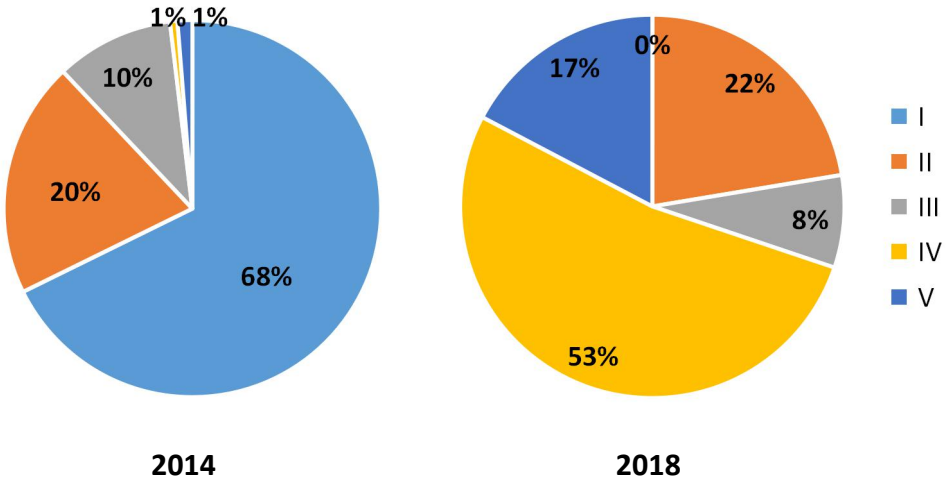

Figure 3. The abundance contribution to the sampled invertebrates according to body length classes in 2014 (left) and 2018 (right).

The increasing biomass index and abundance contribution of middle-sized to large-sized invertebrates suggested that the invertebrates are recovering from the invasion of the Prussian carps (*Carassius gibelio*). As fishing out the Prussian carps will continue, future surveys should pay attention to 1) using the same sampling methods at similar

time of a year, 2) if native fish species are recovering, and 3) if more waterbirds are using the Muumilampi pond as their feeding and/or breeding habitat.

Appendix 1. Details of invertebrates found in the Muumilampi in 2018.

Taxa	Species/Family	1	2	3	4	5	6	7	8	9	10
Araneae	***Argyroneta aquatica***	2	3	3	1	3			4	4	12
Veneroida	***Sphaerium corneum***			5							
Hirudinea	**-**	1	1	1	1						
Gastropoda	***Bithynia tentaculata***			3						1	
	Lymnaea stagnalis	2		1			5	12			1
	Myxas glutinosa			2							
	Radix balthica	1	1		1	12	1		16	30	1
	Planorbarius corneus				1		4	4		7	
Isopoda	***Asellus aquaticus***				6		1			4	18
Diptera	**Podonominae**				10						
	Buchonomyiinae	12	6	9		1		1	8	24	3
Coleoptera	***Acilius canaliculatus***								1		
	Cybister lateralimarginalis		1								
	Hydroporus angustatus		1								
	Rhantus exsoletus					2					
	Enochrus testaceus	1	2				2				
Heteroptera	***Arctocorisa germari***				1	2			1		
	Corixa dentipes						2			3	
	C. punctata							1			
	Notonecta glauca	1			1						1
	N. lutea					1		2			
	Gerridae	1									
Odonata	***Aeshna grandis***								1		
	Cordulia aenea	1	1								
	Leucorrhinia pectoralis									1	
	Sympetrum vulgatum	1									
	Coenagrion pulchellum	1			4						3
Trichoptera	**-**	1	1		2					1	

References

[1] Vanhankaupunginlahden lintuvesi Natura 2000 -alueen hoito- ja käyttösuunnitelma 2015–2024. ISBN (PDF) 978-952-331-220-3.

[2] Sarvanne H. Vanhankaupunginlahden v.2017 Linnuston Seurantalaskentojen Loppuraportti.

[3] Haapanen & Sarvanne. Vanhankaupunginlahden eläinhavaintoja 2017.